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ADDENDUM

ADDENDUM TO 8000A DIGITAL MULTIMETER MANUAL FOR 8000A/mAS OPTION

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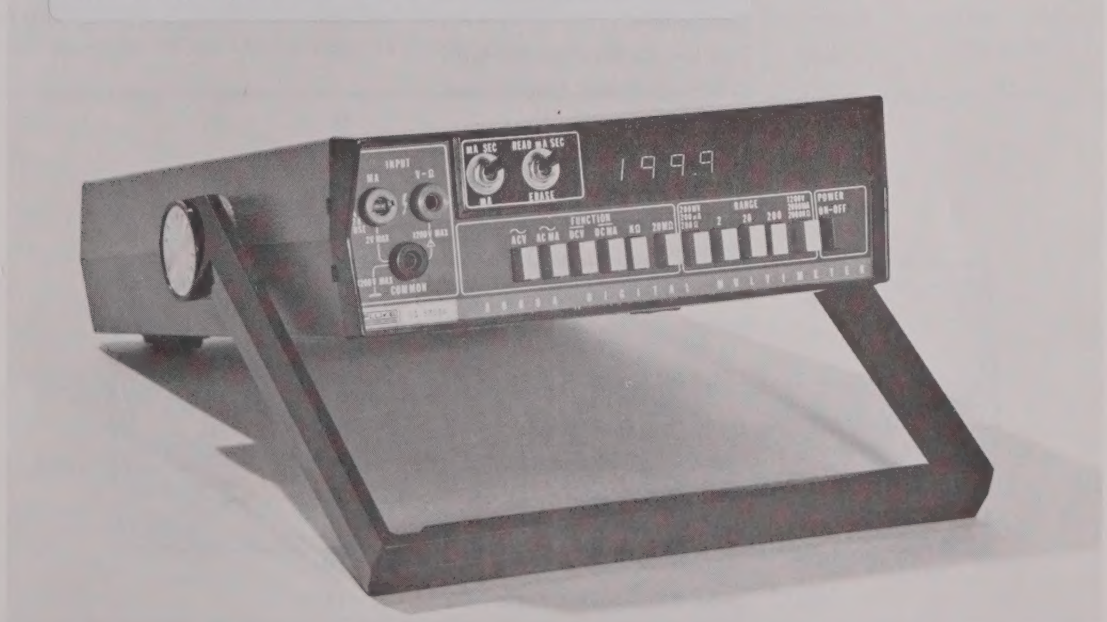


JOHN FLUKE MFG. CO., INC.

PREFACE

This Addendum is intended to be an extension of Section 6, Options and Accessories, of the standard 8000A Digital Multimeter Instruction Manual.

TABLE OF CONTENTS

PARA. NO.	TITLE	PAGE NO.
6-109	8000A/mAS Rev. B Option....	1
6-110	Introduction	1
6-116	Specifications	1
6-118	Operating Instructions	2
6-120	Theory of Operation.....	3
6-125	Maintenance	4
6-134	Calibration	8
6-152	mAS PCB Replaceable Parts ..	10

LIST OF ILLUSTRATIONS

FIG. NO.	TITLE	PAGE NO.
6-20	8000A/mAS Front Panel Controls and Connectors	1
6-21	Input Bridge Rectifier.....	2
6-22	mAS Circuit, Simplified Diagram.....	3
6-23	Test and Calibration Set-Up ...	5
6-24	1-Second Timer Circuit and Parts List	6
6-25	Transient Voltage Protection Circuit Test Set-Up.....	7
6-26	mAS Component Location (3 Sheets)	12
6-27	3-1/2 Digital Multimeter Battery	17

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
6-5	Additional Recommended Test Equipment.....	4
6-6	R16 Selection Chart	9
6-7	Resistance Range Check	10
6-8	mAS Replaceable Parts	11

6-109. 8000A/mAS REV B OPTION

6-110. INTRODUCTION

6-111. The information contained in this Addendum applies to the 8000A Digital Multimeter equipped with the milliamp-Second Rev. B Option, only. This version of the instrument features all the functions of the 8000A with the -01 option, plus the capability of reading the product of current and time. The product of a current and time measurement is displayed in a direct readout of millamp-Seconds.

6-112. Also, the mAS Rev. B pcb contains transient protection circuits that will absorb transients up to 5 kV with 10 μs widths when the instrument is measuring VDC or VAC. This protection is provided in all voltage ranges.

6-113. Another protection device in this version of the instrument features a 47 MΩ Limit resistor connected between circuit common and earth ground. This feature is to prevent failures that could occur when an open ground lead on an 80K-40 High Voltage probe allows the chassis to float toward the high voltage being measured (for example, 25 kV).

6-114. Protection against input currents exceeding 2A is provided just as in the standard instrument. However, this version uses a 500V fuse rather than the 250V fuse used in the standard instrument. Since the 500V fuse is physically larger, it necessitates internal mounting rather than being mounted in the mA input connector.

6-115. Operation of the mA Second mode is accomplished through two toggle switches mounted on the Front Panel just to the left of the Display (refer to Figure 6-20).

6-116. SPECIFICATIONS

6-117. The specifications for the 8000A/mAS are the same as the 8000A-01 with the following exceptions:

Accuracy	
ACV (1 year 15°C to 35°C)	45 Hz to 5 kHz - 10.6% of input +2 digits 5 kHz to 10 kHz - ±1% of input +2 digits 10 kHz to 20 kHz - ±2% of input +2 digits
OHMS (1 year 15°C to 35°C)	200Ω through 2000 kΩ Ranges - ±0.25% of reading + 1 digit. Overload on all ohms ranges - 250 VDC or RMS
millamp-Second (20°C to 30°C).	±1% of input +1 digit. Circuit designed to integrate current pulses of 1 millisecond to 1 second width.
milliamp-Second Ranges (Instrument reads directly in mA Seconds)	2000 mA SEC 200 mA SEC 20 mA SEC 2 mA SEC 200 μA SEC
milliamp-Second Temperature Coefficient	±0.05%/ °C of input +0.1 digit/ °C

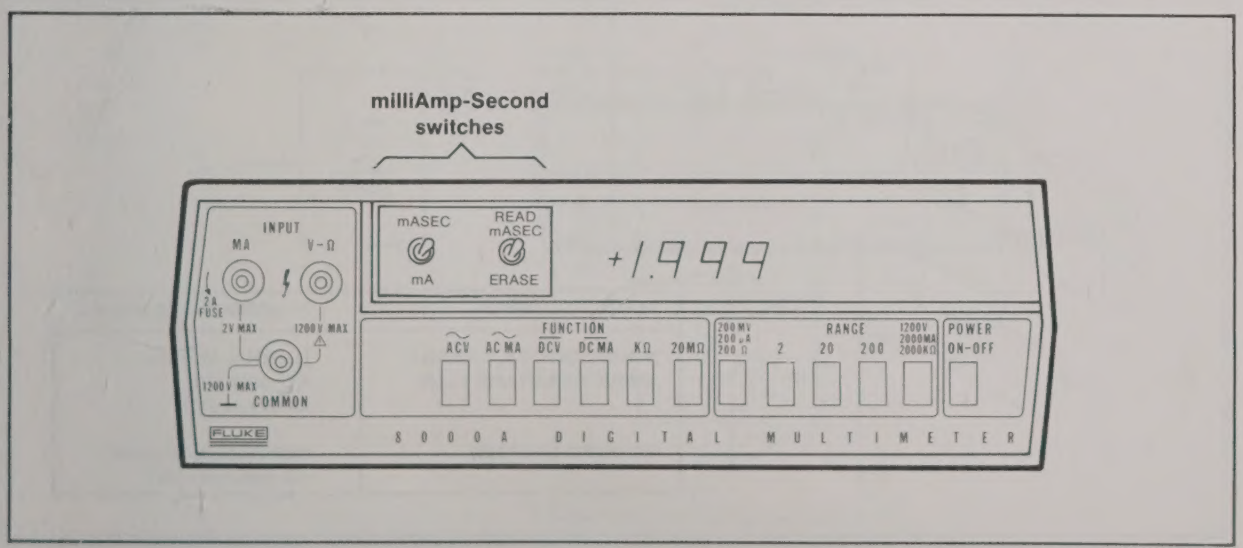


Figure 6-20. 8000A/mAS Front Panel Controls and Connectors

milliamp-Second Polarity	Unit displays negative mA SEC reading for positive current pulse.
Transient Protection (DCV and ACV)	Instrument will not be damaged by transients at the V/Ω input with the amplitude/pulse width combinations of 5000 V/10 μs and 3000V/500 μs.
	Transient repetition rate in pulses/sec = $\frac{0.84}{(V-2000)t}$ where V = pulse amplitude and t = pulse width at 0.707 of peak amplitude.
	Pulses below approximately 2000V do not trigger the suppression circuit and will not affect the measurement.
Voltage Burden in milliamp and millamp-Second modes	1V maximum on 2000 mA range
Input Low to Earth Ground	47 MΩ
Common Mode Rejection (in DCV)	1 kΩ unbalance - 90 dB DC to 60 Hz
	100Ω unbalance - 110 dB DC to 60 Hz
milliamp-Second Drift Rate	1 digit per minute typical with inputs of less than 1% of full scale.
milliamp-Second Hardware	Two toggle switches and a decal added to the Front panel at the left end of the Display.

6-118. OPERATING INSTRUCTIONS

6-119. Operating Instructions for the standard instrument are contained in Section 2 of the 8000A Digital Multimeter Instruction Manual. Use the following procedures to operate the 8000A/mAS in the mA SEC mode:

a. Select DC MA on the standard instrument FUNCTION push button switches.

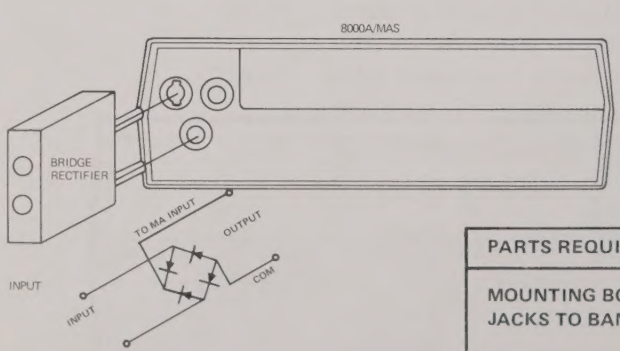
b. Select the desired range on the standard instrument RANGE push button switches.

c. Set the mA/mA SEC switch, on the Front Panel, to the mA SEC position.

d. Set the READ/ERASE switch, on the Front Panel, to the ERASE position for a minimum of 2.0 seconds. The readout should indicate 000 ±1 digit.

NOTE

When using the instrument to measure mA SEC on X-ray machines which do not have Direct Current pulses, a bridge rectifier must be used at the MA input of the 8000A. Refer to Figure 6-21 for a suggested rectifier for this purpose.



PARTS REQUIRED	RECOMMENDED MODEL
MOUNTING BOX, BANANA JACKS TO BANANA PLUG	POMONA MODEL NO. 2098 OR EQUIVALENT
BRIDGE RECEIFIER	MOTOROLA MDA942-1 OR EQUIVALENT

Figure 6-21. Input Bridge Rectifier

e. Set the READ/ERASE switch to READ and apply a current pulse to the MA input of the 8000A.

f. Read the mA SEC value on the Display.

NOTE

The mA SEC value displayed on the readout will be inverted to the actual current. For example, a current which produces a positive indication in the MA mode will produce a negative indication in the mA SEC mode. This is due to an inversion in the mA SEC circuitry and has no affect on the actual value of the readout.

g. Repeat steps d through f for each additional measurement.

6-120. THEORY OF OPERATION

6-121. The operation of the RANGE switches, Current Shunts and FUNCTION switches for the 8000A/mAS is the same as for the standard instrument. A pulse of current applied to the MA INPUT will pass through the RANGE switches and Current Shunts in the normal manner. The pulse from the Current Shunts through S11-D will either be routed to the Active Filter and A/D Converter for a mA reading or to the mA SEC circuit for a mA SEC reading. For the following discussion, assume that S13 is set to the mA SEC (up) position. This will route the output of S11-D to the mA SEC circuit (refer to Figure 6-22 for a simplified diagram of the mA SEC circuit).

6-122. At the input of the mA SEC circuit, the pulse will be applied to Minus and Plus Comparators, U1 and U2 respectively. When either of these Comparators detects a voltage of more than approximately 2 mV, Q5 will be gated ON. This applies the input pulse to the mA SEC Intergrator, U3 and associated components. While the READ/ERASE switch is in the ERASE position, the output of U3 will be held at ∅. However, when the switch is set to the READ position, C5 will be allowed to charge for the duration of the input pulse. The output of U3 will be a ramped voltage which will follow the charge of C5. This output will produce a scaled voltage at the R17 wiper that equals the product of input current and time. The R17 wiper voltage will be routed through S13-B to the Active Filter. The operation of the instrument circuitry from this point to the DISPLAY is identical to that of the standard instrument. Since Q5 is turned OFF at the end of the pulse, the output of U3 will remain constant, therefore, the value of the mA SEC display will remain constant.

6-123. The circuit formed by Q1, Q2 and their associated components, on the mA SEC pcb, is a voltage regulator to produce +10 and -10 volts. This regulated voltage is used as the supply voltage for U1, U2 and U3.

6-124. Also contained on the mAS pcb are two other items which should be mentioned at this point.

a. A High Voltage Protection circuit formed by varistors RV1-RV5.

b. The 1 kΩ calibration adjustment, R1.

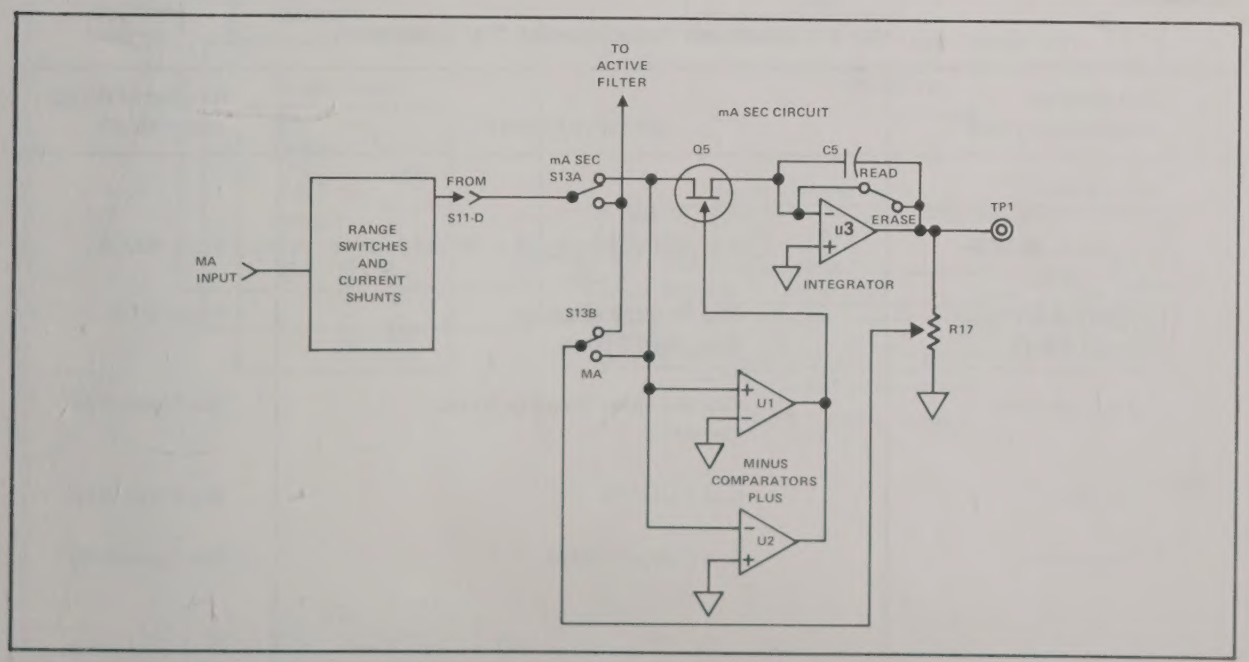


Figure 6-22. mAS Circuit Simplified Diagram

6-125. MAINTENANCE

6-126. The General Maintenance, Performance Test and Calibration information provided in the standard instrument manual applies to the 8000A/mAS with a few exceptions. These exceptions will be discussed in the following paragraphs.

NOTE

This is the third version of an mAS option for the 8000A. The information provided here applies to the 8000A/mAS Rev. B only. For information concerning Rev. Ø and Rev. A, consult the 8000A/mAS-130 document that was supplied with the earlier versions.

6-127. Fuse Replacement

6-128. The Input Power fuse, F1, location, value and replacement are the same as given in the standard instrument manual. However, the Current Shunt protection fuse, F2, is internally mounted and NOT accessible by removing the MA INPUT connector. This is a 2A/500V fuse instead of the 2A/250V fuse used in the standard instrument.

6-128. Performance Test

6-129. The Performance Test information provided in the standard instrument manual is applicable to the 8000A/mAS along with the additional information provided in this addendum. Additional test equipment and test fixtures required for use with the mAS option are given in Table 6-5.

6-130. mA SEC

6-131. Use the following procedure to test the mA SEC function of the 8000A.

a. Connect the test equipment as shown in Figure 6-23. Refer to Figure 6-24 for a list of special parts and schematic of the suggested 1-second timer.

b. Set the 8000A/mAS switches as follows: FUNCTION-DCMA, RANGE-200, mA/mA SEC to mA, and the Timer Operate/Set Current switch to Set Current.

c. Adjust the current source to 100 mA as indicated by the readout of the 8000A/mAS.

d. Set Timer to Operate and 8000A/mAS to mA SEC and ERASE. The reading on the 8000A/mAS should be 00.0 ±0.1 mA SEC.

e. Switch the 8000A/mAS from ERASE to READ and initiate a pulse of current from the Timer.

f. After the pulse, the 8000A/mAS DISPLAY should read -100.0 ±0.2 mA SEC.

g. Change 8000A RANGE to 2000 mA.

h. Switch 8000A mA/mA SEC to mA and Timer to Set Current.

Table 6-5. Additional Recommended Test Equipment

EQUIPMENT NOMENCLATURE	SPECIFICATIONS	RECOMMENDED EQUIPMENT
Digital Multimeter	Ø to 1200V, Ø to 2A, Ø to 20 MΩ	Fluke 8000A
High Voltage Power Supply	Ø to 10 kV, Ø to 10 mA, Regulation 0.001%	Fluke 410B
1-second timer	Provides either Direct or Pulsed current	See Figure 6-24
Resistors	6 ea 1 MΩ/1W	See Figure 6-25
Capacitors	6 ea 0.05 μF/1200V	See Figure 6-25

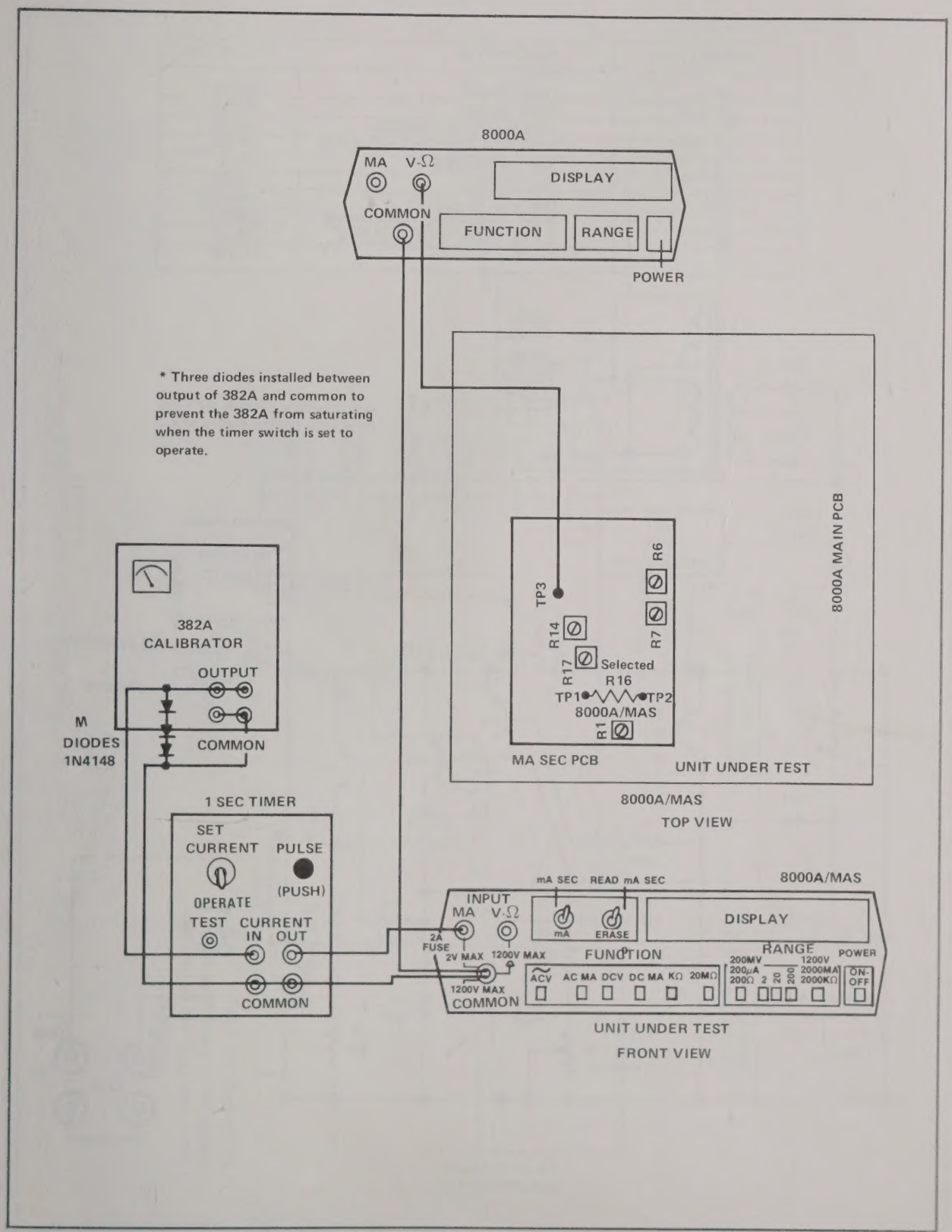


Figure 6-23. Test and Calibration Set-Up

DESIGNATION	DESCRIPTION	FLUKE P/N
CR 1, 2	Diode 1N4004	368738
CR 3, 4	Diode 1N4148	203323
F1	Fuse, Slo-Blo 1/8 Amp MDL	166488
K1	Relay, Mercury, CLARE HGSM1170	196725
Q1-4	Xstr. T1 SKA6808	288761
Q5	Xstr 2N3904	218396
RV1	Regulator, IC, LIN 15V	419044
S1	Switch, Pushbutton, Mom. Contract	370353
S2	Switch, Toggle, DPDT, MST215N	115113
T1	Transformer, Power	345629

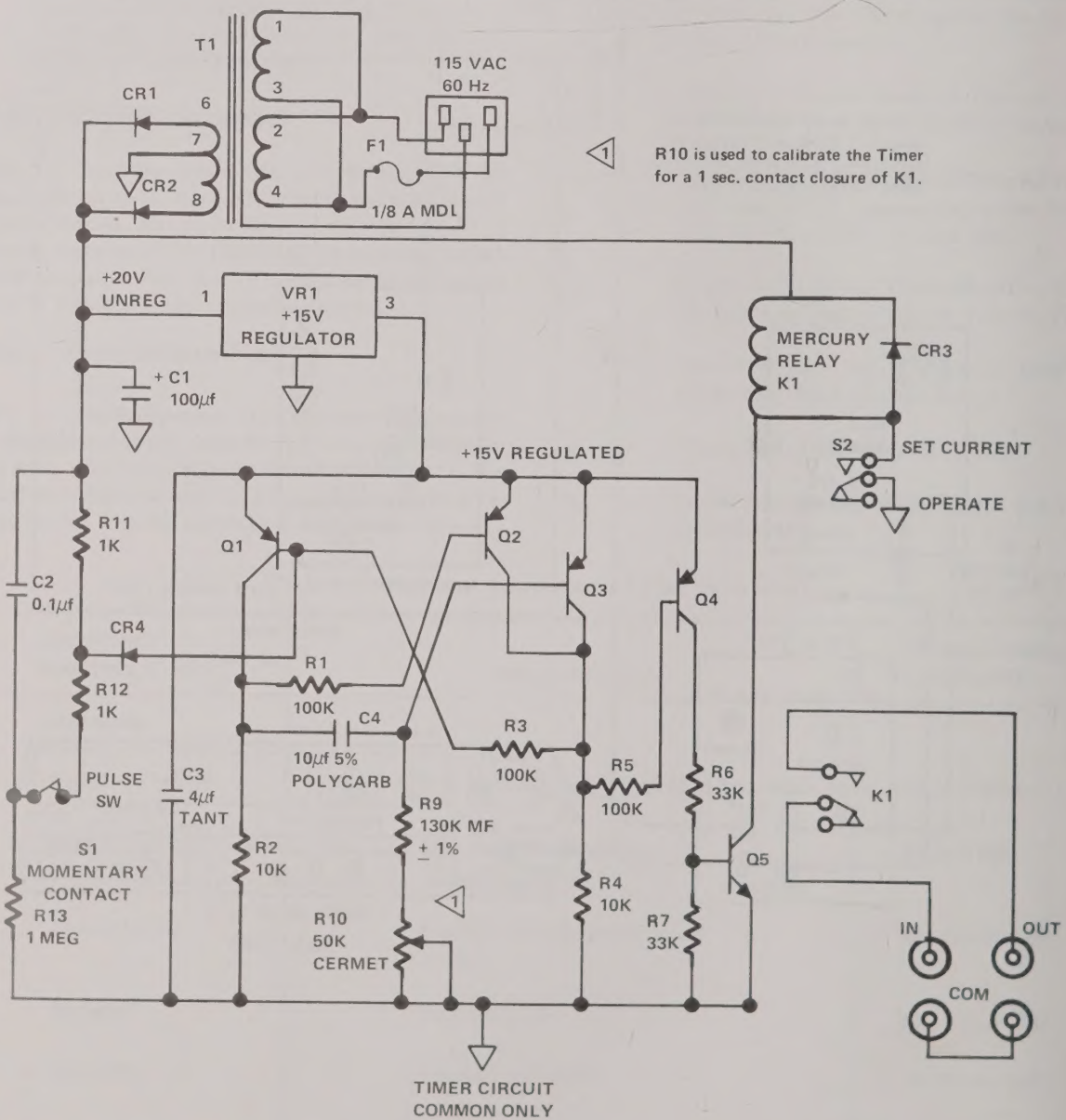


Figure 6-24. 1-Second Timer Circuit and Parts List

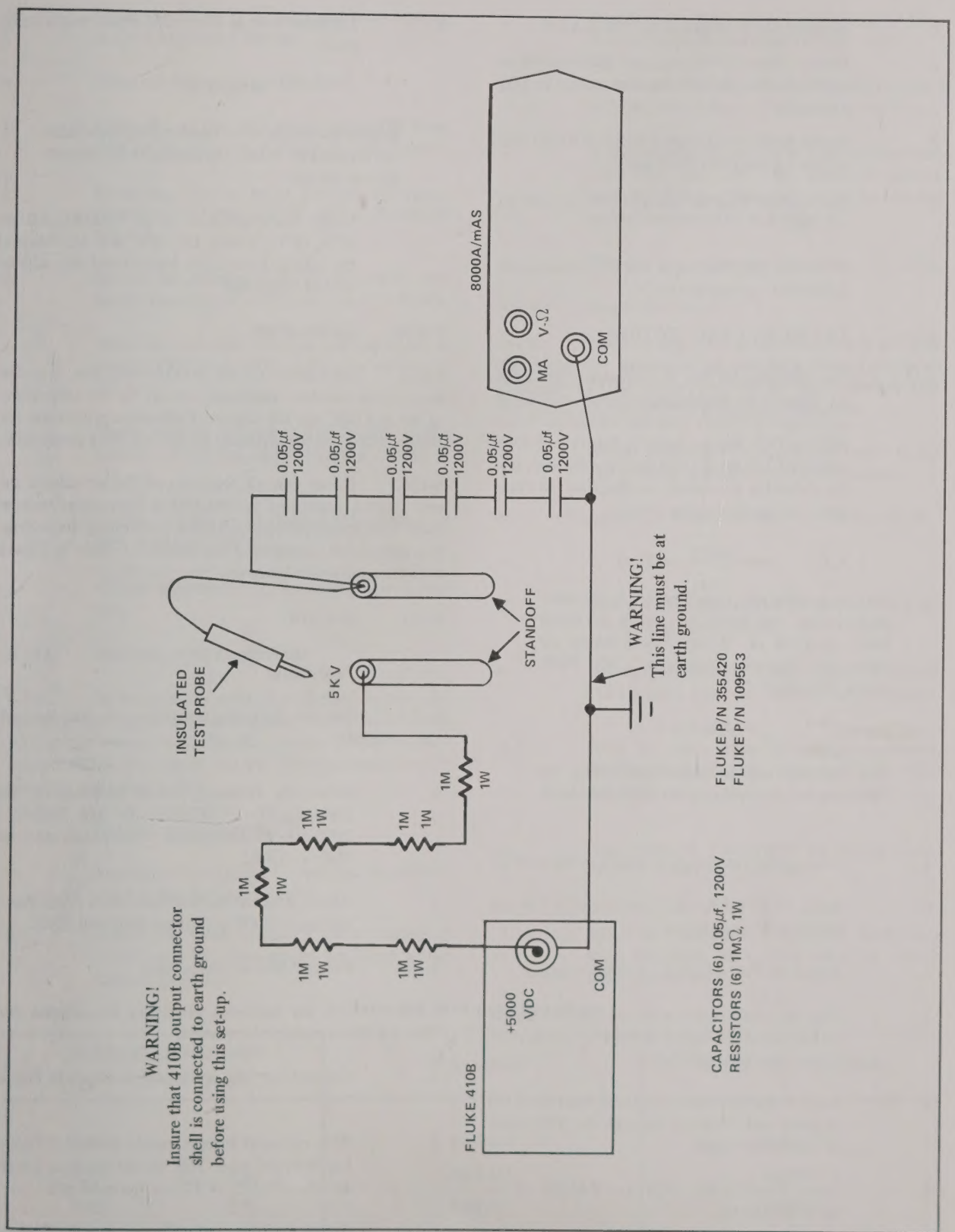


Figure 6-25. Transient Voltage Protection Circuit Test Set-Up

i. Readjust 382A Calibrator for 100 mA DC.

j. Switch Timer to Operate and 8000A/mAS to mA SEC and ERASE. Reading should be 000 ±1 mA DC.

k. Switch 8000A/mAS from ERASE to READ and initiate a pulse from the Timer.

l. The reading, after the pulse, should be -100 ±1 mA SEC.

m. If the mA SEC reading is out of tolerance, see Calibration - paragraph 6-134.

6-132. TRANSIENT PROTECTION

6-133. The 8000A/mAS Rev. B instrument should not be damaged by discharging a capacitor of 0.008 μf, charged to 5000V, into the V/Ω Input in any ACV or DCV Range. Refer to Figure 6-25 for a suggested test setup to be used for this test. Use the following procedure for checking the Transient Voltage Protection circuit:

NOTE

Current limiting and stored energy in the capacitors in this test circuit are within the safety limits specified in "Safety Requirements for Electronic Measuring Apparatus", IEC Publication 348, clause 32.1.

WARNING

Use extreme caution when performing the following test, to avoid possible electrical shock.

a. Connect the Test Set-up as shown in Figure 6-25

b. Select FUNCTION - ACV and RANGE 2 on the 8000A/mAS instrument.

c. Adjust the Fluke 410B for a 5000 V output.

d. Place the insulated test probe on the 5 kV standoff and allow the capacitor bank to charge fully (1 sec. should be sufficient).

e. Remove the insulated test probe from the 5 kV standoff and discharge through the V/Ω input of the 8000A/mAS.

f. Select FUNCTION - DCV and RANGE - 2 on the 8000A/mAS.

g. Repeat steps c, d and e.

h. Transient Voltage Protection circuit test is complete.

WARNING

Reduce the output of or remove the power from the Fluke 410B before attempting to disconnect the test set-up!

i. Verify the calibration of the 8000A/mAS on ACV, DCV, 20MΩ, DC, MA, and AC MA per the 8000A Instruction Manual and this addendum as applicable.

6-134. Calibration

6-135. Calibration of the 8000A/mAS Rev. B is the same as the standard instrument except for the calibration of the mA SEC and kΩ circuits. Calibration procedures for these circuits will be discussed in the following paragraphs.

6-136. Insure that all functions of the instrument except kΩ are calibrated per the 8000A Instruction Manual Field Calibration procedures before performing the calibration procedures contained in this document. Refer to Figure 6-23 for adjustment locations.

6-137 mA SEC

6-138. Zero Adjust

6-139. Use the following procedure to zero the mA SEC Integrator:

a. Select the following switch positions on the 8000A/mAS - FUNCTION - DC MA, RANGE - 2000 mA, READ/ERASE - ERASE and mA/mA SEC - mA SEC.

b. Adjust R14, on the mAS pcb, for a Front Panel reading of 0000 or flashing 0000 and 0001.

6-140. Plus and Minus Comparators

6-141. Use the following procedure to calibrate the Plus and Minus comparator circuits:

a. Connect the test equipment as shown in Figure 6-23.

b. With no input current, rotate R6 and R7 fully counter-clockwise. This should produce a voltage of -15V ±2V at TP3 on the mAS pcb.

c. Switch the Timer to Set Current and the 8000A/mAS mA/mA SEC switch to the mA position.

d. Adjust the Fluke 382A for a +020 mA reading on the 8000A/mAS Display.

e. Select mA SEC on the 8000A/mAS.

f. Adjust R7 on the mAS pcb to switch TP3 from -15V to ØV with the +20 mA ±2 mA current.

g. Verify that the voltage at TP3 is -15V with a current of +17 mA and ØV with a current of +23 mA.

h. Reverse the polarity of the 20 mA current. Use the mA function to verify a current of -020 mA.

i. Select the mA SEC function and adjust R6 to switch TP3 from -15V to ØV at a current of -20 mA ±2 mA.

j. Verify that the voltage at TP3 is -15V with a current of -17 mA and ØV with a current of -23 mA.

k. Switch the Timer to Operate. The voltage at TP3 should be -15V ±2V.

l. Change the polarity of the current back to positive.

6-142. Selection of R16 (mAS pcb)

6-143. In the event any repair is performed on the mAS circuitry, this check should be performed to determine if R16 is the correct value for the operation with the new components in the circuit. Use the following procedure for checking and selecting R16:

a. Connect a voltmeter to TP1.

b. Switch the Timer to Set Current and the 8000A/mAS to the 200 mA RANGE.

c. Adjust the 382A Calibrator for a reading of +100.0 mA DC, then return the Timer to the Operate position.

d. Switch the 8000A/mAS to mA SEC and ERASE. The voltmeter should read 00.0 ±0.1 VDC.

e. Switch the 8000A/mAS from ERASE to READ and initiate a pulse of current from the Timer.

f. After the pulse, the voltmeter shall read between -2.05 VDC and -2.80 VDC. Select the correct value for R16 per Table 6-6. Install the selected resistor between TP1 and TP2.

g. Remove the voltmeter connection from TP1.

6-144. Integrator Output

6-145. The final step in the mAS calibration is to adjust for the correct amount of the Integrator Output voltage to be supplied to the Active Filter and the A/D Converter. Use the following procedure to make this adjustment:

a. Set the 8000A/mAS mA/mA SEC switch to the mA position and the Timer to Set Current.

b. Adjust the 382A Calibrator for 100.00 mA DC.

c. Set the Timer to Operate.

d. Switch the 8000A/mAS to mA SEC and ERASE. The reading should be 00.0 ±0.1 mA SEC.

e. Switch the 8000A/mAS from ERASE to READ and initiate a pulse of current from the Timer.

f. After the pulse, adjust the calibration control, R17 on the mAS pcb, for a reading of -100.0 mA SEC.

g. Repeat steps d, e and f until the reading is consistently -100.0 ±0.2 mA SEC.

h. When the calibration is complete, verify that after the pulse, the reading drifts less than 2 digits per minute.

Table 6-6. R16 Selection Chart

VOLTMETER READING		R16 VALUE	FLUKE PART NUMBER
LO	HI		
-2.05	-2.26	4.12 kΩ	235341
-2.27	-2.48	4.53 kΩ	260331
-2.49	-2.76	4.99 kΩ	168252

6-146. 2000 mA SEC Range Check

6-147. Use the following procedure to check the 2000 mA SEC Range:

a. Change the RANGE selection to 2000 on the 8000A/mAS.

b. Switch the Timer to Set Current and insure that the 382A is adjusted for 100 mA DC. Return the Timer to Operate.

c. Switch the 8000A/mAS to ERASE. The reading should be 000 ±1 mA SEC.

d. Switch the 8000A/mAS from ERASE to READ and initiate a pulse of current from the Timer.

e. After the pulse, the reading should be -100 mA SEC ±1 mA SEC.

6-148. k OHM

6-149. Use the following procedure for the k Ohm calibration of instruments equipped with the mAS Rev. B circuit.

a. On the 8000A/mAS, select FUNCTION - kΩ and RANGE - 200.

b. Connect a precision 190 kΩ resistor across the inputs of the 8000A/mAS.

c. Adjust R12, on the Main pcb, for a reading of 190.0 kΩ. (Refer to Figure 4-1, page 4-5 of the 8000A Instruction Manual for Main pcb adjustment locations.)

d. Select RANGE 2.

e. Connect a precision 1.900 kΩ resistor across the inputs of the 8000A/mAS.

f. Adjust R1, on the mAS pcb, for a reading of 1.900 kΩ. (Refer to Figure 6-23 or 6-26 sheet 3 in this addendum for adjustment locations.)

g. Check the resistance RANGES per Table 6-7.

6-150. RESISTANCE TO EARTH GROUND

a. Input Low terminal to Earth terminal of power plug. Resistance should be 47 MΩ ±5 MΩ.

b. Power plug Low line to earth terminal of Power plug. Resistance should be 3.3 MΩ ±0.3 MΩ.

6-152. mAS PCB Replaceable Parts

6-153. A list of replaceable parts for the mAS pcb is provided in Table 6-8 and component location information is provided in Figure 6-26 sheets 1, 2 and 3.

Table 6-7. Resistance Range Check

FUNCTION	RANGE	INPUT	READING	TOLERANCE
KΩ	200Ω	190Ω	190.0Ω	±5 digits
KΩ	20Ω	19.00 KΩ	19.00 KΩ	±5 digits
KΩ	2000 KΩ	1.9 MΩ	1900 KΩ	±5 digits

Table 6-8. mAS Replaceable Parts

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY, 8000A/mAS (Figure 6-26 Sheet 1)						
1	PCB assy, 8000A/mAS-4001	450239	89536	450239	1		
2	PCB assy, main 8000A-4015	449074	89536	449074	1		
3	Lens, display	424929	89536	424929	1		
4	Washer	200980	89536	200980	2		
5	Decal	424945	89536	424945	1		
S13, 14	Switch, toggle DPDT	11513	95146	MTA206N	2		
6	Bus wire, #26 awg	167228	89536	167228	0.7in.		
7	Sleeving, clear #26	196717	89536	196717	0.4in.		
8	Jack, banana, red	162065	74970	108-902	2		

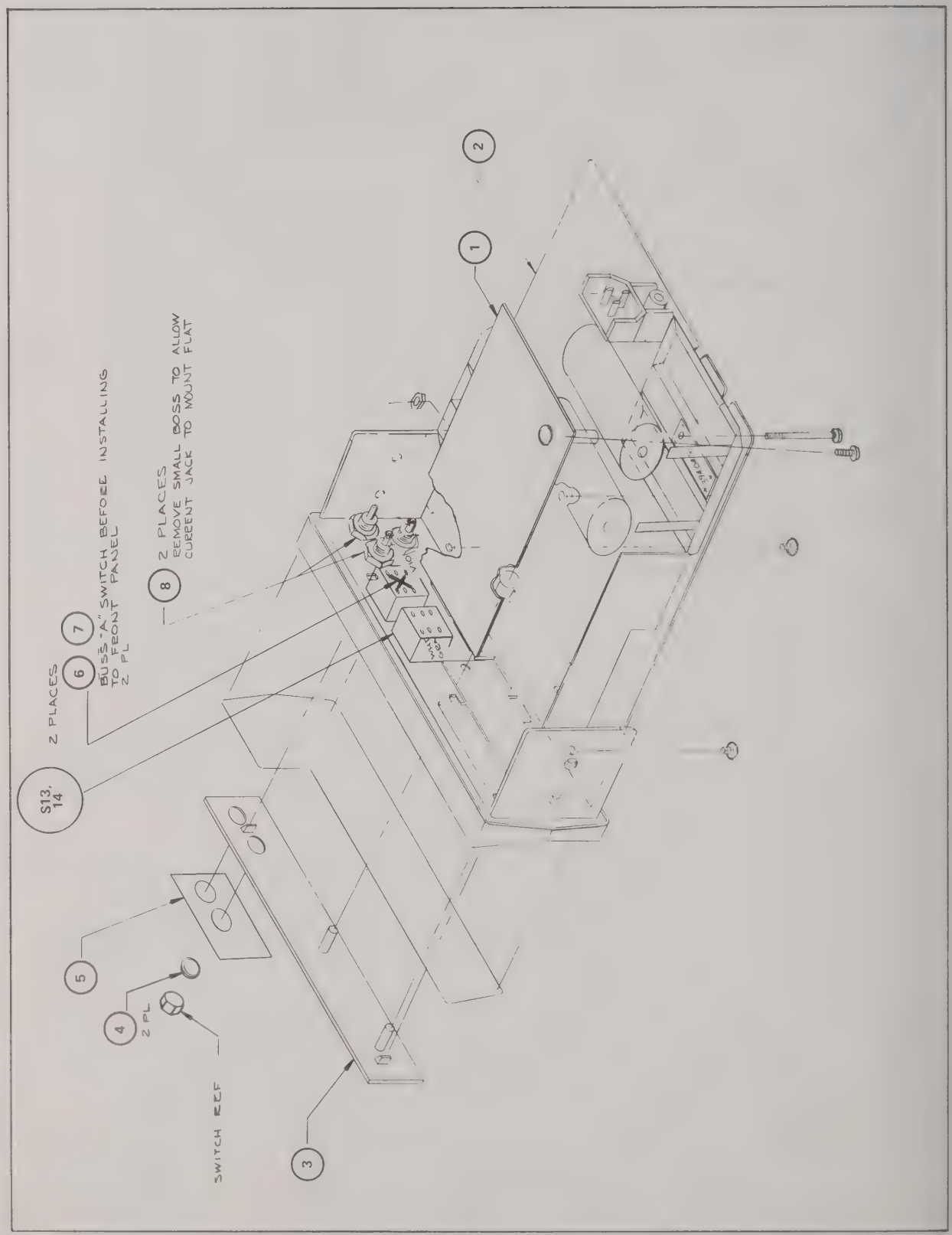


Figure 6-26. mAS Component Location (8000A-4015) (Sheet 1 of 3)

Table 6-8. mAS Replaceable Parts (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY 8000A/mAS (Figure 6-26 Sheet 2)						
9	Assy, fuse brkt, 8000A/mAS-2701	449090	89536	449090	1		
10	Wire, #22 awg, blk	115774	89536	115774	0.5ft.		
11	Fuseholder	446500	71400	4421	1		
F2	Fuse 2A/500V mil. spec. F60C-500V-2A	446492	71400	KLM-2	1		
12	Screw, 6-32 x 3/8	114363	89536	114363	1		
13	Wire, #22 awg, gry	115816	89536	115816	0.2ft.		
14	Nut, 6-32	110569	89536	110569	1		
15	PCB assy, 8000A/mAS-4001	450239	89536	450239	1		
C2	Cap, porcelain, 1 dvdcw 5.1 pf	347948	95275	VY13C5R1C	1		
16	Buss wire, #20 awg	212704	89536	212704	0.7ft.		
17	Sleeving, #18	175976	89536	175976	0.7ft.		
18	Cable assy. 8000A/mAS-4401	450916	89536	450916	1		
19	Wire assy. 8000A/mAS-4403	450981	89536	450981	1		
R69	Res, comp, 15k, ± 10%, 1 W	109421	01121	GB1531	1		
20	Wire assy, W/B 8000A/mAS-4402	450973	89536	450973	1		
21	Wire assy, brn, 8000A/mAS-4404	450965	89536	450965	1		
22	Spacer, nylon, .875 lg	403253	89536	403253	1		
23	Screw, nylon #6	115006	89536	115006	2		
24	Screw	320051	89536	320051	1		

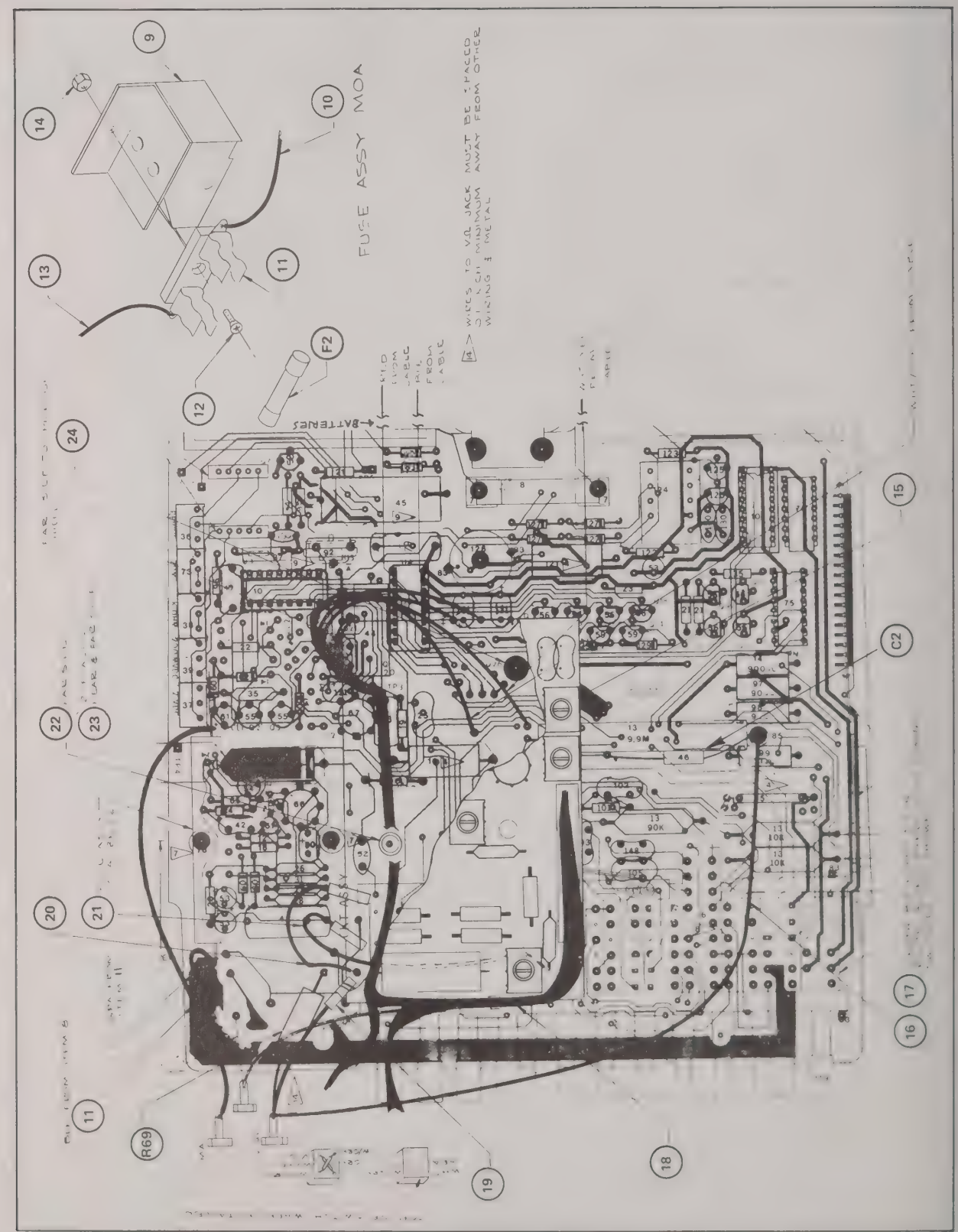


Figure 6-26. mAS Component Location (8000A-4015) (Sheet 2 of 3)

Table 6-8. mAS Replaceable Parts (Concluded)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
25, 26	**mAS PCB ASSY (Figure 6-26 Sheet 3)**						
C1, 2	Cap, Ta, 4.7 μF ±20%, 25V	161943	56289	196D475X-0025 KA1	2		
C3, 4	Cap, mica 240 pF ±5%, 500V	362863	72136	DM15F241J	2		
C5	Cap, polycb, 2.2 μF ±10%, 100V	306522	73445	C280MCH/ A2M2	1		
CR1, 2	Diode, zener, uncomp	340695	12969	UZ8710	2	1	
Q1	Xstr, NPN, Si	168708	09214	2N3391	1	1	
Q2	Xstr, PNP, Si	340026	07263	MPS6563	1	1	
Q3, 4	Xstr, PNP, Si	288761	01295	SKA6808	2	1	
Q5	Xstr, FET, N-channel	261578	07910	U2366E	1	1	
R1	Res, var, 500 ± 10%, ½W	325613	89536	325613	1	1	
R2, 3, 13	Res, car dep, 1k ± 5%, ¼W	343426	80031	CR251-45P102T	3		
R4, 5, 8,-10	Res, car dep, 100k ± 5%, ¼W	348920	80031	CR251-45P104T	5		
R6, 7, 14	Res , var, 10k ± 10%, ¼W	309674	89536	309674	3	1	
R11	Res, mf, 19.1k ± 1%, 1/8W	234963	91637	MFF1-81912F	1		
R12	Res, car dep, 1M, ¼W, 5%	348987	80031	CR251-45P105T	1		
R15	Res, car dep, 220 ± 5%, ¼W	342626	80031	CR251-45P221T	1		
R16	Res, selected per Table 6-6				1		
R17	Res, var, 20 ± 10%, ½W	275727	89536	275727	1	1	
R18	Res, mf, 191 ± 1%, 1/8W	325639	91637	MFF1-81910F	1		
R19	Not used						
R20	Res, fxd, hi-vol, 9.8k ± 1%, 5W	423996	89536	423996	1		
RV1-5	Varistor, hi-vol 390V ± 10%	423475	09214	V390MAX781	5	1	
U1-3	IC, op amp	310037	12040	LH0042C	3	1	

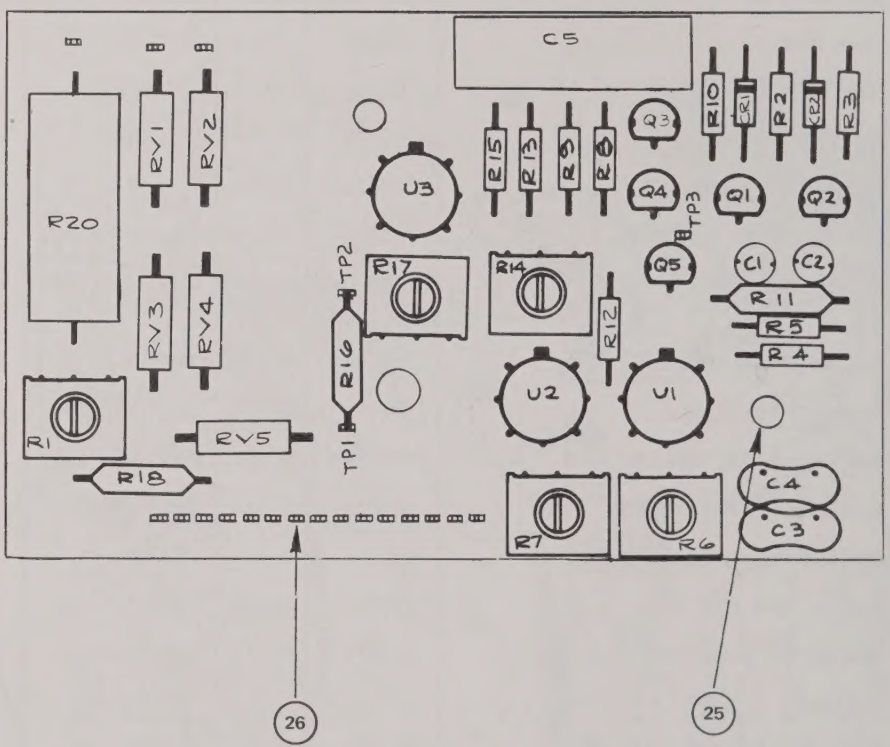


Figure 6-26. mAS Component Location (8000A/mAS-1602) (Sheet 3 of 3)

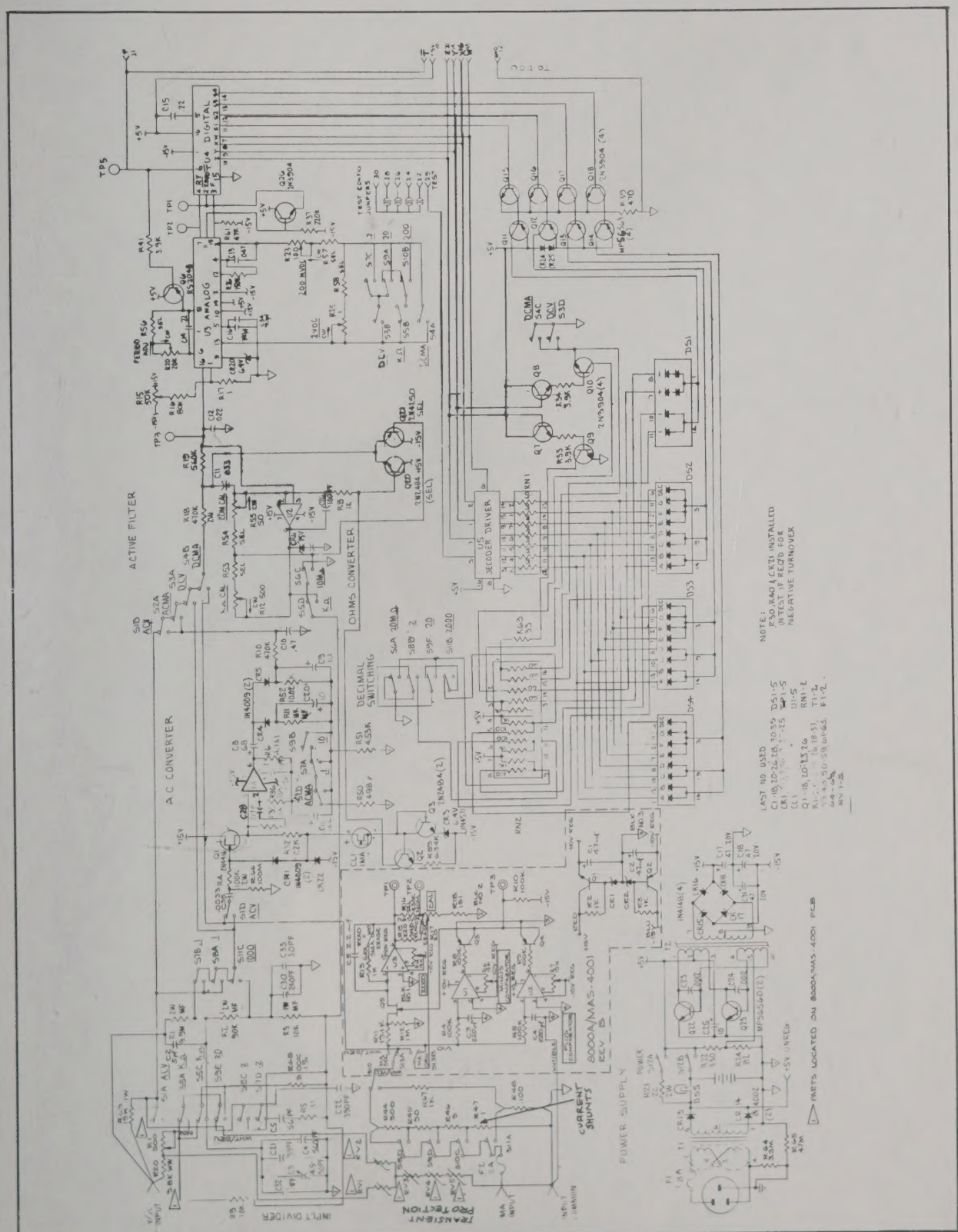


Figure 6-27. 3-1/2 Digital Multimeter Battery (8000a/mAS-1001)

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